Review

Digital geometry: geometric methods for digital picture analysis

Klette R., Rosenfeld A., Morgan Kaufmann Publishers Inc., San Francisco, CA, 2004. Type: Book

Date Reviewed: Nov 19 2004

Full Text

This is another book on picture or image analysis. It differs from existing works in that it focuses on the core of the field (digital geometry), and on related mathematical fundamentals, instead of trying to present yet another, even broader (than in current texts) range of problems, algorithms, heuristics, and "useful" technologies.

Chapter 1 starts with a detailed definition of "picture," and of its fundamental concepts, and then introduces the scientific field of digital geometry, as well as related subjects. Foundations (grids, metrics, and graph theory) are developed in chapters 2 through 5, while chapter 6 is devoted to topology, since this mathematical field offers notions used extensively by digital geometry. Chapters 7 and 8 conclude the introductory part of the book, offering a detailed analysis of the concepts of curve, surface, and solid, from the geometric as well as the topologic points of view.

Chapter 9 starts the main part of the text, with an exhaustive treatise on "2D Straightness." The corresponding three-dimensional (3D) problem ("3D Straightness") is addressed in chapter 11, along with planarity. Chapters 10 and 12 discuss methods to estimate arc-length, and curvature of two-dimensional (2D) and 3D arcs, and techniques to calculate the area and curvature of a surface. Proposed methods are evaluated on the basis of multigrid convergence and computational complexity. Chapter 13 is devoted to important constructs, like convex hulls and Voronoi diagrams, underlying many important applications. Chapters 14, 15, and 16 make up the focus of the book, addressing all the operations that one might need to apply to a picture to solve a particular technical problem: these are various transformations, and morphologic operations, as well as deformations. Chapter 17 concludes the text, with a detailed development of the numerical properties of pictures, and with a brief introduction to spatial relations.

This book has some exceptional features that I did not expect to find in a text on picture processing. Emphasis is placed on fully describing and defining fundamental concepts and constructs, as well as on showing their relevance to classical continuous mathematics, instead of only presenting picture-processing problems and the corresponding algorithmic solutions. Underlying mathematical subjects are fully detailed, making the book completely self-contained; for example, chapter 4 fully covers graphs, while chapters 6 and 7 constitute a wonderful monograph on topology. The figures (presenting enlightening diagrams and sketches, not just digital pictures) are almost as numerous as the pages of the book; they are of high quality, and definitely make the life of the reader much easier. There is no pseudocode, or anything like it, in the text; all algorithms are described using nicely written short explanations and mathematics.

This book would be a great asset for professionals in the field of picture analysis, and would be ideal as a textbook in graduate courses on that subject. One must note that the book uses a standard mathematical/technical language, instead of image processing jargon, and thus is very appropriate for those engineers and scientists in other specialties who need to learn about, and work with, computer pictures.

Reviewer: N. Sapidis

Review #: CR130450